

VIRGINIA GIS REFERENCE BOOK

General Application Name: Police

Product / Service / Function Name: Strategic Planning/Capital Needs

P/S/F Description:

Information technology has offered significant advances during the previous decade for law enforcement. Key among these technologies is Geographic Information Systems (GIS). GIS offers decision makers, command staff and administrative personnel tremendous advantages to collecting, analyzing, describing and communicating information. GIS is often employed by command staff for strategic planning and capital needs to help in five key areas:

1. Understanding Demographic Diversity
2. Analyzing calls for service and recorded incidents for optimizing deployment
3. Analyzing incident hot spots for resource distribution
4. Determining successful policing techniques and mandating accountability
5. Determining crime displacement

This type of analysis can also aid command staff and planners to determine whether or not the current asset allocation is sufficient to meet the safety needs of the community. GIS is an ideal tool to study and analyze the distribution of public safety assets throughout the jurisdiction to determine if the police force has enough resources or if the resources need to be reallocated in a different manner.

Product / Service / Function

1. Spatial Data

Minimum Requirements

General Description	Data Layer
Law Enforcement Data	Incident Locations
Natural Features	Parks
	Open Water
Transportation	Street Centerlines
Socio-Political Data	Municipal Boundary
	Police Zone Boundaries
	Fire Stations, Fire Response Zone Boundaries
	Schools
	Hospitals

Optional Enhancements

General Description	Data Layer
Law Enforcement Data	E911 Call Locations/Calls for Services (CFS)**
Land Base / Planimetric Data	Building Footprints
	Tax Parcels
	Street Lights

	Zoning Districts
	Land Use
Natural Features	100-Year Floodplain
Transportation	Street Double Lines (Right of Way)
	Public Transit Routes
	Railroads
Socio-Political Data	Zip Code Boundaries
	Census Tracts
	Census Block Groups
	Convenience Store & Retail Centers
	Bars
	Social Service Locations
	Prisons
	Neighborhoods & Subdivisions
Other Data	Digital Orthophotography

****Note:** The local law enforcement agency must determine the level of information that is provided to the public, especially when dealing with the location of an incident. The law enforcement agency must weigh the public's right/need to know with the right to privacy of a crime victim and suspect. Therefore, 911 calls for service and incidents are often aggregated into larger groups, such as by block, zip code, police-delineated zone or census block group. This strategy protects the specific information about an incident and provides a summary or total number of events by area.

2. Attribute Data:

Minimum Requirements

General Description	Field Name
Incident Data	Unique Incident Identification Number
	Occurrence Date
	Occurrence Time
	Address
	UCR Code
	Day Code
	Hour
	Patrol Zone
Person Data (aggregate)	Role
	Age
	Race
	Disposition
Property/Vehicle Data (aggregate)	Make
	Model
	Year
	Description
Census Data (aggregate)	Miscellaneous Demographic and Household

Optional Enhancements

General Description	Field Name
Calls for Service (CFS) (aggregate)	CFS
Incident Data (aggregate)	Premise Code
	Jurisdictional Nature Code
	Business
	Modus Operandi
	Drugs
	Domestic Abuse
Property/Vehicle Data (aggregate)	Stolen Value
	Recovered Value
Drugs (aggregate)	Type
	Quantity
Demographic	Census data at the Block Group level
	Population, # Households, # Families
	Male Population, Female Population
	Racial and Hispanic/Latino population breakdowns
	Age population breakdowns

3. Data Acquisition Options

There are many sources for spatial data that a strategic planning and capital needs GIS requires. As previously mentioned, digital incident data can be obtained from the local law enforcement agency's Records Management System (RMS). An RMS can be as simple as a file cabinet full of the police response reports collected by an officer at the scene of an incident. An RMS is, however, most typically a digital database (ex. MS Access, SQL Server, Oracle, mainframe flat-file) that is used to enter these paper reports into a computer for storage. The RMS can then serve as more than a reservoir of incident reports. It can be utilized to generate summary reports, advanced statistical analysis, or as the 'base' from which 'data' is extracted for mapping. Incident data can either be extracted from the RMS on a regularly scheduled basis and placed into a data warehouse, or the crime analysis and mapping system can link directly to this database. The mapping system is then used to geocode, or spatially locate, each event using a street centerline file or a parcels data layer. A street centerline data layer represents each street in a community by a single line that has attached to it its address range. Tax parcels represent a property by a polygon that has information attached to it pertaining to ownership, address, and other assessment data.

The address of an incident record is matched to a parcel or location along the street centerline and a point feature is created to represent that event. Tax parcels are typically maintained at the county level. Street centerline data layers of varying qualities can be obtained by a number of vendors. The market is relatively competitive, and prices will vary with quality of the data. Relevant vendors that provide this kind of spatial data on a regional and national scale include: NAVTECH (www.navtech.com), GDT (www.geographic.com), and TeleAtlas (www.teleatlas.com). Geocoding can also be used to create other data layers that use single

addresses, such as fire stations, schools, hospitals, bars, prisons, convenience store/retails centers, etc.

Other spatial data layers can be obtained through the Internet from various government sources. Municipal boundaries, zip code, Census tract and block group boundaries and their attribute data can be obtained in digital format through the U.S. Census Bureau (www.census.gov). Floodplains can be obtained through the FEMA Web site (www.fema.com).

Land base and planimetric data are typically generated at the county level. County staff may create this data themselves or contract the project out to a consulting firm. This data often includes tax parcels, zoning districts, land use, parks, open water, street double lines (Right of Way), railroads, and E911 dispatch records.

The VBMP orthophotos should be an integral component of a strategic planning and capital needs application. The orthophotos will give police authorities a “bird’s eye view” of area under their jurisdiction. This will allow the authorities to view the distribution of crimes and compare to the current distribution of police resources. This will aid them in identifying patterns and visualizing the efficiency of their police assets.

4. Data Conflation Options

Data conflation is a process by which two digital data layers, usually of the same area at different points in time, or two different data layers of the same area, are geographically “corrected” through geometrical and rotational transformations so that the different layers can be overlaid on one another. Also called “rubber-sheeting,” this process allows a technician to adjust the coordinates of all features on a data layer to provide a more accurate match between known locations and a few data points within the base data set. A good base layer to use for data conflation is the VBMP orthophotos since many features can be seen or interpreted. The need and processes for conflation varies between sets of data, users, and feature types. Any dataset that is updated independently by different departments can be consolidated through conflation. Within most local governments, individual departments are responsible for maintaining specific datasets within their expertise; therefore, conflation is not often necessary. Often, reprojecting the data into a different coordinate system will take care of the misalignment of different data sets. Most industry-standard GIS software has the ability to perform data conflation. Commonly conflated data layers include: parcels, street centerlines, census boundaries, law enforcement boundaries, and any layer that was built using either the parcels or street centerlines.

Each data layer used for strategic planning and capital needs should use the Virginia Base Mapping Project orthophotography for the conflation process. This is vital for data consistency across the state, and facilitates data sharing across jurisdictional boundaries. For example, crime/emergency incidents and street centerlines need to be in the same projection in order to perform any type of spatial analysis.

5. GUI / Programming Options:

There are many options for developers of a strategic planning and capital needs application. The following are three approaches:

- Standard GIS desktop application that can be customized to the user’s needs
- Existing commercial software
- Hiring a consultant to develop a custom system from scratch.

Using a standard GIS application often requires a significant amount of training and customization. Whereas the initial cost may be low, the time invested in learning these solutions may generally increase the overall expense of implementation. Standard GIS software packages deliver more robust data integration, analysis, and cartographic capabilities than do other crime analysis applications. They have a greater user support infrastructure that allows users to overcome problems quickly. Options for using an existing, industry-standard GIS software application that can be customized for a strategic planning include those listed in the following table:

Standard GIS Software Vendors

Vendor	Software	Add-ons	Web Address
ESRI	ArcView 3.x	Crime Analysis Extension	www.esri.com
ESRI	ArcGIS 8.x		www.esri.com
MapInfo	Professional v7.0	CrimeInfo Extension	www.mapinfo.com
Intergraph	GeoMedia 5		www.intergraph.com/gis
Autodesk	Map 5.0		www.autodesk.com

There are an increasing number of vendors developing and implementing strategic planning application software. These products may often cost more than standard GIS solutions because of the customization that is required to fit the application into the agency's business practices and/or connect to its CFS database or RMS. The advantage is that a tailored law enforcement application provides just the functionality that is needed, decreasing the overall application overhead common to industry-standard GIS software. Options for using an existing, commercial application include those listed in the following table:

Commercial Software

Vendor	Software	Web Address
GeoDecisions	GeoCAMS	www.geodecisions.com
Omega Group	CrimeView	www.theomegagroup.com
NIJ/ESRI	Community Policing Beat Book	www.esri.com/industries/lawenforce/beatbook.html

The final option for developing and implementing a strategic planning and capital needs application is to contract a consultant. This option makes certain that a product will fulfill an agency's requirements. Unlike the first option, which requires the law enforcement agency to modify its own process/technology to fit the system, the system fits existing business practices. A consultant will be able to develop an application that works with the wide range of CFS databases and RMSs that currently exist within the state. Also, training and follow-up user support is often provided at a much more substantial level than with other options.

7. Technical Requirements

Minimum Technical Requirements

At its most basic level, a strategic planning and capital needs GIS application can be used on a single, stand-alone workstation. This workstation would have a hard drive that stores all of the spatial data layers, as well as a database containing a copy of all of the incident records for the law enforcement agency. A typical workstation running off-the-shelf software should have the following minimum specifications:

Processor:	Pentium 3, 450 MHz
RAM:	128MB SDRAM at 133MHz
Hard Disk:	20GB (min.)
Monitor 1:	19"
Floppy Drive:	3.5"
CD-ROM:	12x/8x/32x CD drive
Modem:	56K
OS:	Windows 2000/NT/XP
Office:	Windows 2000 Professional
Printer:	8x11 office-grade color printer

Optimum Technical Requirements:

A more complex application may require multiple components, including servers, desktop workstations, ruggedized laptops, and/or handheld devices. For either a client-server or a Web-based application, the system should rely on a fairly robust server computer and high-end workstations. Example specifications of the necessary equipment are listed below:

Server

Processor:	Min. 2x Processors, 1.7 GHz, 512K cache
RAM:	Min. 2x 512MB RIMMS
Hard Disk:	Min. 2x 80GB +RAID
Monitor 1:	19"
Floppy Drive:	3.5"
CD-ROM:	12x/8x/32x CD drive
Modem:	56K
Network Card:	10/100 mbps

Workstation

Processor:	Pentium 4, 1.5 GHz
RAM:	512MB SDRAM at 133MHz
Hard Disk:	20GB (min.)
Monitor 1:	19"
Monitor 2:	17"
Floppy Drive:	3.5"
CD-ROM:	12x/8x/32x CD-RW drive
Modem:	56K
Network Card:	10/100 mbps
OS:	Windows 2000/NT/XP
Office:	Windows 2000 Professional

Other Components

Printer:	8x11 office-grade color printer and 8x11 production b/w printer
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Plotter: HP DesignJet 1055CM
Tape Backup: Tape Library Server
UPS: APC 1400 (or other similar)
Scanner: 11x17
Handheld: Compaq IPAQ
Network: T1

8. Administrative/Management Requirements

At the beginning of the project, the assigned project manager of the local law enforcement jurisdiction should consider completing some, if not all of the following tasks that relate to the administrative requirements of a strategic planning and capital needs application:

- Determine, with or without the assistance of a consultant hired to develop the system, the preliminary vision and goals of the project.
- Determine the stakeholders (e.g. operational command staff, financial/budgetary administrative units) of a strategic planning and capital needs project within their own jurisdiction and with larger government entities that they interact with.
- Coordinate an initial stakeholders meeting where the vision and goals of the project are expressed and the background of GIS technology is described, if needed.
- Coordinate with other municipal agencies for data sharing provisions.
- Determine a mechanism of communication to keep the stakeholders aware of the progress of the project.
- Develop a basic understanding of the available precedents in their region/state and research the available technologies that can be applied to their project.

Upon project completion, a simple strategic planning and capital needs GIS will require very little administrative support. Administrative tasks may include loading or upgrading new versions of the software or patches, providing for constant data flow from the 911 dispatch database or RMS, and maintaining yearly support contracts on the hardware and software. However, once the system becomes distributed, there are various other management requirements that need to be fulfilled on a weekly or monthly basis.

At the point where the system grows beyond single desktop users, a devoted administrator or system manager needs to be established. This is essential for the following reasons:

- The system will now be interfacing with other technology systems already in place. Therefore, someone needs to maintain contact with the technology personnel that maintain these systems.
- The manager needs to put into place quarterly training schedules to maintain user knowledge of the system.
- Funding will undoubtedly be required to either maintain the system long-term, or continue to expand the system, which requires funding research and applications for grants.
- A strategic planning and capital needs GIS application project only succeeds when it is implemented on a weekly basis with rigorous analysis and planning.

9. Costs:

Hardware	Typical Unit Cost
Minimum Workstation	\$2,000
Optimum Workstation	\$3,200
Laptop	\$2,400
Web/FTP Server	\$8,500
Database Server	\$12,000
Data Warehouse Server	\$18,000
Backup Server	\$5,800
Printer (8x11 color)	\$700
Printer (8x11 b/w production)	\$2,000
Plotter	\$12,000
Tape Library	\$5,000
UPS	\$700
Scanner	\$1,500
Handheld	\$300-\$700

Software (all prices included license)	Typical Unit Cost
Standard GIS desktop software	\$700-\$10,000
Desktop vendor application	\$2,000-\$6,000
Customized desktop vendor solution	\$5,000-\$15,000
Web-based vendor application	\$15,000-\$25,000
Customized web-based vendor solution	\$20,000-\$60,000

Miscellaneous	Typical Unit Cost
Training – focused vendor training (per person)	\$700-\$1,000
Training – general GIS	\$700-\$1,200
Licensing-desktop	\$100-\$500
Licensing-webapp (1st CPU)	\$7,500-\$12,000
Maintenance (per year)	\$8,000-\$15,000

10. Standards / Guidelines Summary

- Always maintain a unique identification number with every incident, spatial feature, and event recorded within the system.
- Standardize street naming conventions to make certain of proper geocoding.
- If there are multiple streets with the same name (e.g., Main St.) then standardize additional fields, such as borough name or zip code, that are collected to differentiate the streets.
- Create standard Common Place-name file.

McDonald's	236 Johnson St
Grant Statue	14 th St. & Willits St
Central Park	1500 Warrington Rd
The Pit	6550 Templeton Ln
K&A	Kensington Ave & Allegheny Ave

- Collect zip code for all incidents. This facilitates cross-jurisdictional information sharing.
- Standardize use of Uniform Crime Reporting codes statewide.
- Standardize date and time conventions.
- Develop a detailed Quality Assurance/Quality Control (QA/QC) procedure for reviewing the accuracy of the GIS data and its attributes.

- Maintain data in the VBMP standard coordinate system (Virginia State Plane, NAD 83, Survey Feet).
- Create metadata (standard information about GIS data) for each data layer. Metadata tracks the date, origin, coordinate system, and other such information for data layers.

11. Startup Procedures/Steps

There should be a minimum of eight steps involved with a strategic planning and capital needs project after funding is in place to support the project. The steps can be performed in-house or by a consulting team. They include a needs assessment, functional requirements documentation, data development, system development and testing, installation and testing, user training, planning for future development, and ongoing technical support.

The first task is to complete a detailed Needs Assessment. This process gathers information regarding existing operational procedures, hardware and software, crime data, and personnel needs. It should include interviews of key individuals throughout the law enforcement agency and other related government departments to obtain a comprehensive view of the agency's operations, and where GIS might improve them. Basic GIS concepts should be discussed and illustrated to those interviewees that have little prior understanding of GIS or crime mapping.

It is at this time that the project group should discuss the relevance or desire to develop functionality within the system to help in the five key areas mentioned in the introduction:

1. Understanding Demographic Diversity
2. Analyzing calls for service and recorded incidents for optimizing deployment
3. Analyzing incident hot spots for resource distribution
4. Determining successful policing techniques and mandating accountability
5. Determining crime displacement

By understanding demographic diversity within a law enforcement jurisdiction command staff might realize the dynamic nature of population and household economies. These will typically play a role in the distribution of crime incidents and asset management throughout the jurisdiction. It will also give command staff an understanding of special needs of the public. These needs may impact the structure of community outreach programs, neighborhood watches, and hiring policies.

Analyzing calls for service (CFS) and recorded incidents helps command personnel and asset managers more effectively deploy their patrol resources. A simple method to accomplish this is aggregating the total CFS and recorded incidents for each police zone within a jurisdiction. By comparing these totals and their percentage of the whole, analysts can demonstrate or justify a need for increased or decreased patrol. Another method of studying CFS and incidents is by tracking and aggregating the temporal distribution of the events. By viewing these records by totals per day over a week, or by viewing the records by total per week over a month, command staff can more effectively determine the loads that they need to prepare for each shift per precinct. Maps that display the percentage change over a standard time interval (week/month) offer a final method that command staff can quickly analyze a jurisdiction's activity and subsequently allow for the proper deployment of resources.

Hot spots occur when a short-term pattern evolves in a specific geographic location. There are many software applications and processes utilized to determine hot spot locations. These are helpful to identify for command staff because they can be utilized to trigger an increase in asset allocation to that area before the hot spot escalates.

Determining successful policing techniques and mandating accountability is the basis of the COMPSTAT policing process. Essentially, the COMPSTAT process requires the collection, analysis, and mapping of crime data and other performance measures. Police managers are then accountable for their performance as measured by the data. It is based on four highly successful principles that can be supported by utilizing GIS technology:

- Accurate and timely data
- Effective tactical response to crime
- Optimized and rapid deployment
- Relentless investigation and assessment

Finally, a successful strategic planning and capital needs application assists command staff and managers to determine whether or not the policing strategies have positively impacted crime displacement. “Pushing” crime to other areas remains a goal for law enforcement to attain. By pushing criminals into less familiar zones of activity they are more likely to commit crimes successfully. However the “cost” of committing a crime increases. The hopes are that the potential criminal realizes that the cost of committing the crime will outweigh the rewards of the crime. In this situation even a simple crime and asset management system will facilitate this analysis.

The second task is to develop a functional requirements document for the proposed system. This document should describe, as completely as possible, all of the technology and functionality that is to be included in the strategic planning application. This document is used by the law enforcement agency and its consultant as the blueprint for the application and/or system. It should include the following:

- Hardware specifications
- Software purchases
- Detailed descriptions of work-flow, and examples of the graphic user interfaces
- Describe each tool that is part of that graphic user interface, and its functionality
- Describe how data would flow between the different databases and data warehouses, if applicable
- Describe the redundant security measures that will be put in place to make certain of data integrity and confidentiality, when applicable
- Analytical techniques that the application/system provides the user for queries and analysis
- Describe each of the potential products (reports, maps, charts, summary tables) that the user will be able to generate within the system

The third task should be to compile or develop a law-enforcement-specific spatial data set that can be used by the GIS-based strategic planning and capital needs application, which can be gathered from a number of online sources, as well as county departments. The data layers gathered and maintained should match at least the minimum list provided in Section 1 of this document. At this point, the method of data collection and attributes collected pertaining to an incident should be studied and modified as needed. This might require changes to the agency’s RMS. If changes are warranted, it will be worthwhile in the long run to compile additional information for analysis.

On completion and acceptance of the functional requirements document and the development of the spatial and attribute data, the system development and test phase can begin. During this time,

the application will be developed as it was outlined in the functional requirements phase. The law enforcement agency should require periodic reviews of the application at particular milestones, such as 50% and 75% completion. This will make certain that problems with the application will be recognized early in the development process, and that the law enforcement agency remains a part of the development process throughout the project timeline.

When the system is nearing 100% completion, it should be installed and tested in the environment in which it will ultimately be used. This allows the users to test the system alongside the application developers, and determine any system integration problems that might arise. It also gives the developers the opportunity to test the application's functionality in a real-world situation. This testing process should be as comprehensive as possible. Each process detailed within the functional requirements should be tested and evaluated at this point.

User training commences once the application reaches 100% completion and is fully documented. Different levels of tutorials and system documentation should be developed depending on the hierarchy of users. Time should be spent at this stage of the project with each potential user of the system to make certain that the proper education occurs. Training should be done through lessons that use real-life examples of system application. This strategy greatly enhances users' ability to apply the functionality to their jobs.

The next phase of the project should include a document that describes a future plan for wider system development. This document accomplishes two goals. The future plan gives the local government agency ideas on how the system might grow to assist other facets of its business practices. Secondly, it provides the agency with a ready-made grant proposal for applying for potential funding sources.

The final phase of a successful strategic planning and capital needs application is ongoing technical support. The law enforcement agency should always include this contingency within its cost estimates of a project for a minimum of three months after a system has been put into place. No matter how effective an application appears, problems and system changes inevitably impact the functionality of a system.

12. Estimated time line and/or implementation (stand alone) schedule:

Phase	Duration
RFP/Contract process (construction, posting, proposal acceptance, review, award of contract)	4 months - 1 year
Needs Assessment	1 month
Functional Requirements	1-2 months
Data Development	2-3 months
System Development and Testing	2-4 months
Installation and Testing	1 month
User Training	½ month
Plan for Future Development	¼ month
Ongoing Support	3 months

13. Best Practice Examples in Virginia

Fairfax County
Police Department
4100 Chain Bridge Road
Fairfax, VA 22030
703-246-2195
<http://www.co.fairfax.va.us/ps/police/homepage.htm>

University of Virginia Police Department
2304 Ivy Road
Charlottesville, VA 22903
434-924-7166
<http://www.virginia.edu/uvapolice/>

City of Newport News Police Dept.
2600 Washington Ave.
Newport News, VA 23607
www.ci.newport-news.va.us/police/beatmap.htm

Virginia Institute for Justice Information Systems (VIJIS)
RECAP Program
<http://vijis.sys.virginia.edu>